Bolt Hole Circle (PCD) Chart

Equally spaced holes - how the coordinates work, chord factors, and 3 to 6 holes.

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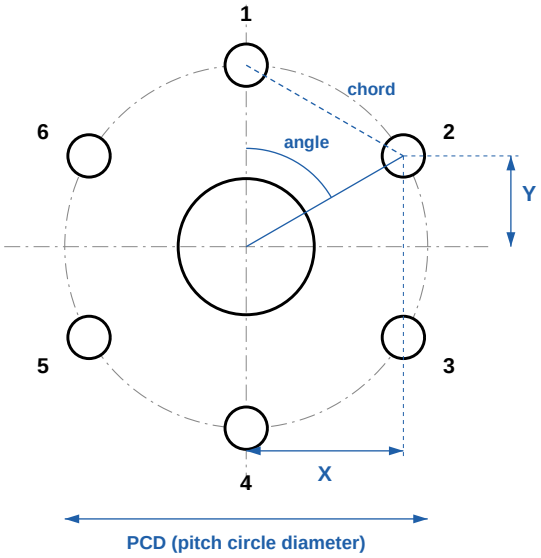
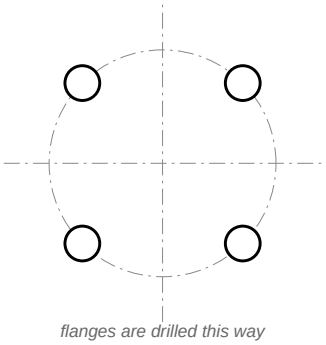
On the centreline (hole 1 at 12 o'clock)



Straddling the centreline



flanges are drilled this way

Angle = (hole - 1) x 360 / holes, clockwise from 12 o'clock.
X = PCD / 2 x sin(angle)
Y = PCD / 2 x cos(angle)
Straddling: add half the pitch angle (180 / holes).
Chord (hole to hole) = PCD x sin(180 / holes).
Example: 6 holes on 150 PCD, hole 2: X = 150 x 0.4330 = 64.95, Y = 150 x 0.2500 = 37.50 mm.
Signs: X + right, - left; Y + up, - down from the centre. Set the DRO to zero on the centre.

Chord factors (hole-to-hole spacing = PCD x factor) and 6 holes

Holes	Pitch angle	Chord factor	Chord on 100 PCD
3	120°	0.86603	86.60
4	90°	0.70711	70.71
5	72°	0.58779	58.78
6	60°	0.50000	50.00
7	51.43°	0.43388	43.39
8	45°	0.38268	38.27
9	40°	0.34202	34.20
10	36°	0.30902	30.90
12	30°	0.25882	25.88
14	25.71°	0.22252	22.25
16	22.5°	0.19509	19.51
18	20°	0.17365	17.36
20	18°	0.15643	15.64
24	15°	0.13053	13.05

Hole	Angle	X	Y	Xs	Ys
1	0°	0.0000	0.5000	0.2500	0.4330
2	60°	0.4330	0.2500	0.5000	0.0000
3	120°	0.4330	-0.2500	0.2500	-0.4330
4	180°	0.0000	-0.5000	-0.2500	-0.4330
5	240°	-0.4330	-0.2500	-0.5000	0.0000
6	300°	-0.4330	0.2500	-0.2500	0.4330

Coordinates for PCD = 1 (multiply by your PCD) - 3, 4 and 5 holes. Xs, Ys = straddling pattern

Hole	Angle	X	Y	Xs	Ys
1	0°	0.0000	0.5000	0.4330	0.2500
2	120°	0.4330	-0.2500	0.0000	-0.5000
3	240°	-0.4330	-0.2500	-0.4330	0.2500

Hole	Angle	X	Y	Xs	Ys
1	0°	0.0000	0.5000	0.3536	0.3536
2	90°	0.5000	0.0000	0.3536	-0.3536
3	180°	0.0000	-0.5000	-0.3536	-0.3536
4	270°	-0.5000	0.0000	-0.3536	0.3536

Hole	Angle	X	Y	Xs	Ys
1	0°	0.0000	0.5000	0.2939	0.4045
2	72°	0.4755	0.1545	0.4755	-0.1545
3	144°	0.2939	-0.4045	0.0000	-0.5000
4	216°	-0.2939	-0.4045	-0.4755	-0.1545
5	288°	-0.4755	0.1545	-0.2939	0.4045

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Coordinates for 8, 10, 12 and 16 holes (PCD = 1 - multiply by your PCD). Xs, Ys = straddling the centreline

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8 holes and 10 holes

Hole	Angle	X	Y	Xs	Ys
1	0°	0.0000	0.5000	0.1913	0.4619
2	45°	0.3536	0.3536	0.4619	0.1913
3	90°	0.5000	0.0000	0.4619	-0.1913
4	135°	0.3536	-0.3536	0.1913	-0.4619
5	180°	0.0000	-0.5000	-0.1913	-0.4619
6	225°	-0.3536	-0.3536	-0.4619	-0.1913
7	270°	-0.5000	0.0000	-0.4619	0.1913
8	315°	-0.3536	0.3536	-0.1913	0.4619

Hole	Angle	X	Y	Xs	Ys
1	0°	0.0000	0.5000	0.1545	0.4755
2	36°	0.2939	0.4045	0.4045	0.2939
3	72°	0.4755	0.1545	0.5000	0.0000
4	108°	0.4755	-0.1545	0.4045	-0.2939
5	144°	0.2939	-0.4045	0.1545	-0.4755
6	180°	0.0000	-0.5000	-0.1545	-0.4755
7	216°	-0.2939	-0.4045	-0.4045	-0.2939
8	252°	-0.4755	-0.1545	-0.5000	0.0000
9	288°	-0.4755	0.1545	-0.4045	0.2939
10	324°	-0.2939	0.4045	-0.1545	0.4755

12 holes and 16 holes

Hole	Angle	X	Y	Xs	Ys
1	0°	0.0000	0.5000	0.1294	0.4830
2	30°	0.2500	0.4330	0.3536	0.3536
3	60°	0.4330	0.2500	0.4830	0.1294
4	90°	0.5000	0.0000	0.4830	-0.1294
5	120°	0.4330	-0.2500	0.3536	-0.3536
6	150°	0.2500	-0.4330	0.1294	-0.4830
7	180°	0.0000	-0.5000	-0.1294	-0.4830
8	210°	-0.2500	-0.4330	-0.3536	-0.3536
9	240°	-0.4330	-0.2500	-0.4830	-0.1294
10	270°	-0.5000	0.0000	-0.4830	0.1294
11	300°	-0.4330	0.2500	-0.3536	0.3536
12	330°	-0.2500	0.4330	-0.1294	0.4830

Hole	Angle	X	Y	Xs	Ys
1	0°	0.0000	0.5000	0.0975	0.4904
2	22.5°	0.1913	0.4619	0.2778	0.4157
3	45°	0.3536	0.3536	0.4157	0.2778
4	67.5°	0.4619	0.1913	0.4904	0.0975
5	90°	0.5000	0.0000	0.4904	-0.0975
6	112.5°	0.4619	-0.1913	0.4157	-0.2778
7	135°	0.3536	-0.3536	0.2778	-0.4157
8	157.5°	0.1913	-0.4619	0.0975	-0.4904
9	180°	0.0000	-0.5000	-0.0975	-0.4904
10	202.5°	-0.1913	-0.4619	-0.2778	-0.4157
11	225°	-0.3536	-0.3536	-0.4157	-0.2778
12	247.5°	-0.4619	-0.1913	-0.4904	-0.0975
13	270°	-0.5000	0.0000	-0.4904	0.0975
14	292.5°	-0.4619	0.1913	-0.4157	0.2778
15	315°	-0.3536	0.3536	-0.2778	0.4157
16	337.5°	-0.1913	0.4619	-0.0975	0.4904

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Standard flange drilling - EN 1092-1 PN10 / PN16, ANSI B16.5 Class 150 and BS 10 Table D / E.

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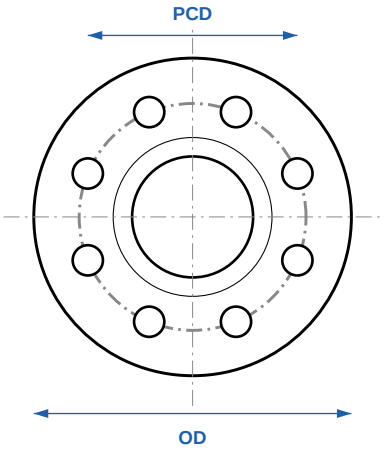

Identify a flange by measuring the OD, the PCD (centre of one hole to the centre of the opposite hole, or hole edge to far edge of the opposite hole) and counting the holes. Flange holes always straddle the centrelines.
EN 1092-1 PN10 and PN16 share dimensions up to DN150. ANSI Class 150 matches none of them. BS 10 Table D and E (older British and Zimbabwean plant) share OD and PCD but differ in bolt count and size above 3" - Table E is the heavier. Where the tables agree, a flange of one standard will often bolt to another; always check the hole count.
Hole size: bolt diameter + 2 mm (metric) or + 1/8" (inch).

EN 1092-1 (DIN) PN16 and PN10

DN	OD mm	PCD mm	PN16 bolts	Hole mm	PN10 if different
15	95	65	4 x M12	14	same
20	105	75	4 x M12	14	same
25	115	85	4 x M12	14	same
32	140	100	4 x M16	18	same
40	150	110	4 x M16	18	same
50	165	125	4 x M16	18	same
65	185	145	8 x M16	18	same
80	200	160	8 x M16	18	same
100	220	180	8 x M16	18	same
125	250	210	8 x M16	18	same
150	285	240	8 x M20	22	same
200	340	295	12 x M20	22	8 x M20, PCD 295
250	405	355	12 x M24	26	12 x M20, OD 395, PCD 350
300	460	410	12 x M24	26	12 x M20, OD 445, PCD 400

ANSI B16.5 Class 150

NPS	OD in	OD mm	Bolt circle in	Bolt circle mm	Bolts
1/2"	3.50	89	2.38	60.5	4 x 1/2"
3/4"	3.88	99	2.75	69.8	4 x 1/2"
1"	4.25	108	3.12	79.2	4 x 1/2"
1.1/4"	4.62	117	3.50	88.9	4 x 1/2"
1.1/2"	5.00	127	3.88	98.6	4 x 1/2"
2"	6.00	152	4.75	120.6	4 x 5/8"
2.1/2"	7.00	178	5.50	139.7	4 x 5/8"
3"	7.50	190	6.00	152.4	4 x 5/8"
4"	9.00	229	7.50	190.5	8 x 5/8"
5"	10.00	254	8.50	215.9	8 x 3/4"
6"	11.00	279	9.50	241.3	8 x 3/4"
8"	13.50	343	11.75	298.4	8 x 3/4"
10"	16.00	406	14.25	361.9	12 x 7/8"
12"	19.00	483	17.00	431.8	12 x 7/8"

BS 10 Table D and Table E

Size	OD in	OD mm	PCD in	PCD mm	Table D bolts	Table E bolts
1/2"	3.75	95	2.625	66.7	4 x 1/2"	4 x 1/2"
3/4"	4	102	2.875	73.0	4 x 1/2"	4 x 1/2"
1"	4.5	114	3.25	82.5	4 x 1/2"	4 x 1/2"
1.1/4"	4.75	121	3.4375	87.3	4 x 1/2"	4 x 1/2"
1.1/2"	5.25	133	3.875	98.4	4 x 1/2"	4 x 1/2"
2"	6	152	4.5	114.3	4 x 5/8"	4 x 5/8"
2.1/2"	6.5	165	5	127.0	4 x 5/8"	4 x 5/8"
3"	7.25	184	5.75	146.0	4 x 5/8"	4 x 5/8"
4"	8.5	216	7	177.8	4 x 5/8"	8 x 5/8"
5"	10	254	8.25	209.5	8 x 5/8"	8 x 3/4"
6"	11	279	9.25	234.9	8 x 5/8"	8 x 3/4"
8"	13.25	337	11.5	292.1	8 x 5/8"	8 x 3/4"
10"	16	406	14	355.6	8 x 3/4"	12 x 3/4"
12"	18	457	16	406.4	12 x 3/4"	12 x 7/8"

Coordinates are for PCD = 1 - multiply by your PCD. Flange data nominal - check the standard or the mating flange.